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### Search History

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L15: Entry 26 of 27

File: USPT

Mar 14, 2000

US-PAT-NO: 6038540

DOCUMENT-IDENTIFIER: US 6038540 A

TITLE: System for real-time economic optimizing of manufacturing process control

DATE-ISSUED: March 14, 2000

## INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
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Lapere; Martine R.	Knokke-Heist			BE
Wassink; Steven Groot	Axel			NL
Koolen; Johannes L. A.	Terneuzen			NL
Sprenkels; Jacobus C. M.	Terneuzen			NL

## ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
The Dow Chemical Company	Midland	MI			02

APPL-NO: 08/963882 [\[PALM\]](#)

DATE FILED: November 4, 1997

## PARENT-CASE:

CROSS-REFERENCE TO RELATED APPLICATION This is a continuation of application Ser. No. 08/399,288 filed Mar. 6, 1995, now abandoned and which is a continuation in part of Ser. No. 08/210,191 now U.S. Pat. No. 5,486,995 filed Mar. 17, 1994.

INT-CL-ISSUED: [07] G06 F 17/18, G05 B 13/04

US-CL-ISSUED: 705/8; 364/156

US-CL-CURRENT: 705/8; 700/36

FIELD-OF-CLASSIFICATION-SEARCH: 705/8, 705/9, 705/11, 364/148.01, 364/151, 364/152, 364/154, 364/156, 364/161-163

See application file for complete search history.

## PRIOR-ART-DISCLOSED:

## U. S. PATENT DOCUMENTS

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PAT-NO	ISSUE-DATE	PATENTEE-NAME	US-CL
<input type="checkbox"/> <u>4547858</u>	October 1985	Horak	364/513

<input type="checkbox"/>	<u>4723214</u>	February 1988	Frei	364/434
<input type="checkbox"/>	<u>4809154</u>	February 1989	Newton	364/148
<input type="checkbox"/>	<u>4812990</u>	March 1989	Adams et al.	364/444
<input type="checkbox"/>	<u>5033004</u>	July 1991	Vandivier, III	364/468
<input type="checkbox"/>	<u>5396416</u>	March 1995	Berkowitz et al.	364/165

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FOREIGN-PAT-NO	PUBN-DATE	COUNTRY	CLASS
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ART-UNIT: 271

PRIMARY-EXAMINER: Poinvil; Frantzy

ATTY-AGENT-FIRM: Schultz; Dale H.

ABSTRACT:

The present invention provides an adaptive process control and profit depiction system which is responsive to both process measurement input signals, economic inputs, and physical environment inputs. The process control system features an interactive optimization modeling system for determining manipulated process variables (also known as setpoints). These manipulated process variables are used to position mechanisms which control attributes of a manufacturing system, such as a valve controlling the temperature of a coolant or a valve controlling the flow rate in a steam line.

18 Claims, 30 Drawing figures

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L15: Entry 26 of 27

File: USPT

Mar 14, 2000

DOCUMENT-IDENTIFIER: US 6038540 A

TITLE: System for real-time economic optimizing of manufacturing process control

Detailed Description Text (144):

Detailed Parameter Model Solution Step 905 is performed by SOLO Executive Engine 820 after a Yes conclusion to Reconciliation Data Plausibility Decision Step 904. SOLO Executive Engine 820 writes to and prompts optimizer engine 822 to solve the detailed parameter model for the entire set of parameters needed by the Economic Setpoints model. In executing Detailed Parameter Model Solution Step 905, data values which were solved for as a balanced set in Reconcile Reduced Model Operation Step 903 are read from Data Common 821 and used in place of the real-time values resident in Data Common 821 (as acquired from Process Control Computer 71 via Communication Interface 72) associated with the same logical identifier in Process Control Computer 71. In this regard, the estimated data (as a balanced set) resulting from the solution of the formulated reconciliation problem is more appropriate for the solution of the formulated parameter estimation problem since local noise effects and minor process transients have been mathematically reconciled in the prior Reconcile Reduced Model Operation Step 903. It is an important feature of this invention that the solution of Detailed Parameter Model Solution Step 905 using input data values from Reconcile Reduced Model Operation Step 903 is superior in the optimization process to a solution of Detailed Parameter Model Solution Step 905 using input data values from process variables within Process Control Computer 71 without a prior reconciliation process. Economic balances are best performed using defined parameters, and defined parameters are best calculated based upon balanced components. A steady state dynamic status to indicate equilibrium in the operation of the manufacturing system 70 is a prerequisite for a balanced component determination. SOLO Executive Engine 820 writes to and prompts optimizer engine 822 to solve the detailed parameter model for the manufacturing system 70. Optimizer engine 822 reads and references parameter objective function and plant model 803 to acquire the formulated detailed parameter problem, and optimizer engine 822 subsequently reads and references Data Common 821 for data values to solve the detailed parameter problem. Optimizer engine 822 then writes and inputs data resulting from the solution of the formulated detailed parameter problem into Data Common 821. SOLO Executive Engine 820 proceeds to Parameter Data Plausibility Decision Step 906 after optimizer engine 822 completes its task.

Detailed Description Text (248):

The logic of the computation of profit in SOLO Executive Engine 820 (which outputs a value to actual profit subfunction 818) alternatively further executes to identify significant real-time changes in at least one of the variable manufacturing margin values related to the profit meters. Furthermore, the logic of the computation of profit in SOLO Executive Engine 820 also identifies associated real-time changes, in response to a status of an identified significant real-time change respecting at least one of the variable manufacturing margin values related to the profit meters, in at least one of the input values related to the variable manufacturing margin values. Furthermore, in the case of two or more input values related to the variable manufacturing margin values, the logic of the computation of profit in SOLO Executive Engine 820 also executes to rank order the input values by the amount or degree of their respective changes. In this regard, the logic

respectively utilizes a criteria factor based upon a band of acceptable deviation in either (1) the variable manufacturing margin values related to the profit meters or (2) the input values related to the variable manufacturing margin values to define a basis for a significance status value indicating significant change. A set of at least one such significance status value is then output by the system of the present invention as information related to the significance of change in the variable manufacturing margin. In one alternative, such information is output as a set of associated quantitative detail which is rank-ordered by the quantitative magnitude of significance status values, according to pre-defined criteria respecting the impact on profit. This rank ordered set of associated data is depicted on computer monitor 74 (in one embodiment, with the "instantaneous profit meter", "modulated profit meter", and "rigorous profit meter" outputs) via actual profit subfunction 818 to generate a comprehensive perspective regarding the status of the operation of manufacturing system 70. In one embodiment, each set of information related to a particular significance status value is further associated with a message label 2503, to facilitate rapid understanding by the human operator 78 of the relevance of the set of information. In this manner, the present invention enables a diagnostic functionality directed toward identification of issues related to operational variable manufacturing margin of a manufacturing process 70. One example of a diagnostics display 2501 from computer monitor 74 is shown in FIG. 25. The upper part of FIG. 25 depicts a historical variable manufacturing margin plot 2502 plotted within the context of a Cartesian coordinate axis 2504 related to time and the quantitative magnitude of the variable manufacturing margin. The lower part of FIG. 25 shows examples of individual instances of message label 2503 related to the most significant status value calculated at particular historical reference times. In the first three individual instances of message label 2503 shown in FIG. 25, actual data related to input values is also incorporated into appropriate fields of message label 2503.

Current US Class (2):  
705

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L15: Entry 27 of 27

File: USPT

Jun 2, 1998

US-PAT-NO: 5761441

DOCUMENT-IDENTIFIER: US 5761441 A

TITLE: Data processing system for analyzing and administering a stock investment limited-recourse borrowing contract

DATE-ISSUED: June 2, 1998

## INVENTOR-INFORMATION:

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APPL-NO: 08/520381 [PALM]

DATE FILED: August 29, 1995

INT-CL-ISSUED: [06] G06 F 17/60

US-CL-ISSUED: 395/235

US-CL-CURRENT: 705/35FIELD-OF-CLASSIFICATION-SEARCH: 395/235, 395/236, 395/237, 395/238, 395/239  
See application file for complete search history.

ART-UNIT: 241

PRIMARY-EXAMINER: Hayes; Gail O.

ASSISTANT-EXAMINER: Oh; Junghoon Kenneth

ATTY-AGENT-FIRM: Brumbaugh, Graves, Donohue &amp; Raymond

## ABSTRACT:

A data processing system analyzes a stock investment limited recourse borrowing contract. The system receives and processes as input data on the date of analysis (1) contract data including the identity and amount of the collateral stock, the amount of the initial loan and the minimum and maximum interest rate percentages payable by the investor under the contract; (2) actual data relating to the stock prior to the analysis date including its market prices per share at selected regular intervals and the dividends per share paid in a selected number of quarters; and (3) estimated data relating to the stock from the analysis date to the end of the contract term including its estimated market price per share at intervals and the estimated dividends per share to be paid. The programmed processor processes the input data and produces as output data (1) calculated average growth rates of market prices per share and dividends per share; (2) projected amounts of interest to be paid by the investor in each period of the contract and of the amounts and timing of principal repayments to be made by the

investor to the lender; and (3) projected average internal rates of return to both the investor and the lender over the life of the contract on their investments under the contract by discounting over the contract term all of the inflows and outflows of value to the investor and to the lender based on actual and projected market prices per share and dividends per share.

10 Claims, 18 Drawing figures

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L15: Entry 27 of 27

File: USPT

Jun 2, 1998

DOCUMENT-IDENTIFIER: US 5761441 A

TITLE: Data processing system for analyzing and administering a stock investment limited-recourse borrowing contract

**Abstract Text (1):**

A data processing system analyzes a stock investment limited recourse borrowing contract. The system receives and processes as input data on the date of analysis (1) contract data including the identity and amount of the collateral stock, the amount of the initial loan and the minimum and maximum interest rate percentages payable by the investor under the contract; (2) actual data relating to the stock prior to the analysis date including its market prices per share at selected regular intervals and the dividends per share paid in a selected number of quarters; and (3) estimated data relating to the stock from the analysis date to the end of the contract term including its estimated market price per share at intervals and the estimated dividends per share to be paid. The programmed processor processes the input data and produces as output data (1) calculated average growth rates of market prices per share and dividends per share; (2) projected amounts of interest to be paid by the investor in each period of the contract and of the amounts and timing of principal repayments to be made by the investor to the lender; and (3) projected average internal rates of return to both the investor and the lender over the life of the contract on their investments under the contract by discounting over the contract term all of the inflows and outflows of value to the investor and to the lender based on actual and projected market prices per share and dividends per share.

**Brief Summary Text (11):**

(iii) actual data on the market price of the stock and on dividends paid on the stock during a period of years prior to the contract and during the period, if any, between the start of the contract and the value date for which an analysis is being prepared; and

**Brief Summary Text (12):**

(iv) estimated data including estimates of share market prices and dividends on selected dates from the contract start and from value date to the end of the contract.

**Brief Summary Text (16):**

(iii) for use in termination decisions, estimates of future market prices and dividends on dates subsequent to the dates having the latest available actual data prepared by extrapolating the growth rates exhibited by the actual data over a specified prior period; and

**Brief Summary Text (28):**

If any one of the variables is changed, the potential value of the contract to the investor, to the lender, or to both may change, and a change in any variable may affect the position of a party during negotiation of a contract and may change his actions during the life of a contract. The data processing system of the present invention enables both the investor and the lender, prior to entering into a

contract and at any time during its life, to determine their prospective rates of investment return. The processing system provides results virtually instantaneously and is indispensable to the negotiations setting the size of the loan and its set of interest terms. By updating stock prices, dividend payments, and Treasury note interest rates with actual data during the course of the contract, thereby triggering appropriate changes in projections, both the investor and the lender may determine what future payments are likely to be required and whether it is, or is not, likely to be advantageous to exercise the right of early termination for which the contract provides.

Brief Summary Text (29) :

Over the life of the contract the proportion of the input based on actual data increases and the proportion based on projected and calculated data decreases.

Detailed Description Text (39) :

If he wishes, for example, to enter new information regarding a recent dividend on the Market Data page on block 112, data input page 4, FIG. 10, the user chooses to go to that page, where actual data on share prices and dividends at the start of the contract, at the value date and in a number of other past quarters are displayed along with estimated data for each remaining quarter of the contract period. The data on this page for quarter-end share prices are the generally conveniently available data for the prices of the last stock exchange trades in those quarters. For all uses in the contract, however, when it is allowed to run its full course, the share prices for the day of the contract start, the value date, and the day of the contract end are from the closing trades on the most recent previous trading dates. When in block 112 he enters new actual data, he replaces previously estimated entries on that page, and the effects of that new data are automatically taken into account in revisions of all projections. By such entries the proportion of forecast data in the analysis is gradually reduced over the life of the contract. On the FIG. 10 example page, the actual data for periods prior to the value date are shown in bold print. The forecast data are shown on three different bases: within the boxes as estimated by the participants at the contract start and as estimated on the value date by the preparer of the revised case, and outside the boxes as automatically projected by extrapolation from actual data for calculations used in early termination analysis. This last set of projections for use in termination decisions is not left to the possibly self-interested discretion of the preparer but is created by assuming that the data subsequent to the value date fall along a continuation of a constant quarterly rate of growth curve calculated by the computer program as the best fit, on a least squares basis, to the actual data for a recent period, in this case twelve quarters.

Detailed Description Text (43) :

On the basis of actual data and projections as of the value date as shown on the example display in FIG. 14, the computer program calculates that the investor would receive returns on his investment of his own funds over the contract period of 15.81% if he continued to hold the shares after the contract period and 10.99% if he sold all the shares. The higher return is that which he would ultimately have earned if the shares remain in his possession until his death in view of the fact that under current federal, and most state, laws appreciation in the value of a decedent's assets from the date of acquisition to the date of death are not subject to capital gains tax. These internal rates of return, both of which are displayed on the Summary page, FIG. 8, are derived from the columns of investor net value flows in FIG. 14 by calculations which use computer iteration to determine the daily discount rate which makes the sum of the discounted values of future flows, when discounted daily back to the date of the initial investment, equal in total to the sign-reversed value of the initial investment. Specifically, if the initial investment at time 0 is represented by  $F_0$ , the next flow one quarter later by  $F_1$ , the next flow by  $F_2$ , etc., then the daily discount rate  $D$  expressed as a percentage is determined by the formula  $\text{##EQU1##}$  for a five-year (1825-day) contract period.

The annual earnings rate is 365 times the calculated daily discount rate D.

Current US Class (1):

705

CLAIMS:

1. A data processing system for analyzing and administering before and upon its inception and at any time thereafter a stock investment limited recourse borrowing contract under which an investor borrows on a limited recourse basis from a lender a substantial proportion not exceeding one half the value of the shares of a specified corporation placed as collateral in the hands of a trustee on the basis of an undertaking by the investor to pay to the lender an amount of interest varying, within the range of a minimum percentage and a maximum percentage, with the amount of dividends paid on the collateral stock, with the investor's obligation to pay interest being unconditional but with the obligation to repay the original borrowing being limited to the value of the collateral stock at the end of the contract period, comprising

programmed data processing and storage means for receiving and storing the following input data on a current date when the system is used prospectively or retrospectively to analyze the contract on a date of analysis:

(1) contract data including the identity and amount of the collateral stock, the amount of the initial loan and the minimum and maximum interest rate percentages;

(2) actual data relating to the stock including its market price per share at the end of each of a selected number of quarters preceding the date of the analysis and on the trading date preceding the contract start and the dividend per share, if, any, paid in each of a selected number of quarters preceding the date of analysis;

(3) and estimated data relating to the stock including its estimated market price per share at the end of each quarter during the remaining life of the contract after the date of analysis and at the contract end and the estimated dividend per share, if any, to be paid during each of the remaining quarters of the contract;

means for processing the input data and producing the following output data therefrom:

(1) the calculations of average growth rates of market prices per share and dividends per share both for a period prior to the contract start and for the term of the contract by determining constant growth rate curves which minimize the sum of the squares of the deviations of the actual and projected market prices per share and dividends per share from the corresponding data points on the curves;

(2) projections of the amounts of interest to be paid by the investor in each period of the contract and of the amounts and timing of principal repayments to be made by the investor to the lender; and

(3) projections of the average internal rates of return to both the investor and the lender over the life of the contract on their investments under the contract by discounting over the contract term all of the inflows and outflows of value to the investor and to the lender based on actual and projected market prices per share and dividends per share

and means for producing a report that includes the following information;

(1) the identities of the investor, lender and trustee;

(2) the identity, amount and value of the collateral;

- (3) the amount of the loan;
- (4) the contract dates; and
- (5) the output data.

7. A data processing system according to claim 1 wherein the input data are periodically updated during the term of the contract to include actual market prices per share of the stock and actual dividend payments per share so that over the life of the contract in the calculation of internal rates of return the significance of forecast data declines and the significance of actual data increases.

8. A data processing system for analyzing and administering before and upon its inception and at any time thereafter a stock investment limited recourse borrowing contract under which an investor borrows on a limited recourse basis from a lender a substantial proportion not exceeding one half the value of the shares of a specified corporation placed as collateral in the hands of a trustee on the basis of an undertaking by the investor to pay to the lender an amount of interest varying, within the range of a minimum and a maximum percentage, with the amount of dividends paid on the collateral stock, with the investor's obligation to pay interest being unconditional but with the obligation to repay the original borrowing being limited to the value of the collateral stock at the end of the contract period, comprising

programmed data processing and storage means for receiving and storing the following input data on a current date when the system is used prospectively or retrospectively to analyze the contract:

- (1) contract data including the identity and amount of the collateral stock and the amount of the initial loan and the minimum and maximum interest rate percentages;
- (2) actual data relating to the stock including its market price per share at the end of each of a selected number of quarters preceding the current date and on the trading date next preceding the contract start and the dividend per share, if any, paid during each of a selected number of quarters preceding the current date;
- (3) and estimated data relating to the stock including its estimated market price per share at the end of each quarter during the remaining life of the contract and at the contract end and the dividend per share, if any, to be paid during each the remaining quarters of the contract;

means for processing the input data and producing the following output data therefrom:

- (1) calculations of average growth rates of stock prices per share and dividends per share both for a period prior to the contract start and for the term of the contract by determining constant growth rate curves which minimize the sum of the squares of the deviations of the actual and projected data from corresponding data points on the curves;
- (2) projections of future stock prices per share and dividends per share determined by extrapolating growth rates per share calculated for the actual data of selected past period;
- (3) projections of the amount of interest to be paid by the investor in each period of the contract and of the amounts and timing of principal repayments to be made by the investor;

(4) projections of the average internal rates of return of both investor and the lender over the life of the contract on their investments under the contract determined by discounting over the contract term all of the inflows and outflows of value to the investor and to the lender based on actual and projected stock prices and dividends;

(5) projections of the amounts of interest and principal which the investor would have to pay to the lender on the termination date if the investor or, alternatively, the lender chose to exercise the right contained in the contract to terminate the contract early and projections of the future rates of return foregone by the lender in the event of such early termination; and

(6) projections of the internal rates of return which would have been earned by the investor if he had invested the same amount of his own after-tax funds in the same stock for the same period without benefit of the contract

and means for producing report that includes the following information:

- (1) the identities of the investor, lender and trustee;
- (2) the identity, amount and value of the collateral;
- (3) the amount of the loan;
- (4) the contract dates; and
- (5) the output data.

10. A data processing system according to claim 8 wherein the input data are periodically updated during the term of the contract to include actual market prices per share of the stock and actual dividend payments per share so that over the life of the contract in the calculations of internal rates of return the significance of forecast data declines and the significance of actual data increases.

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